# TENMARS

## RF three-Axis Field Strength Meter

## TM-196

User's Manual

CE

HB2TM1960001

TENMARS ELECTRONICS CO., LTD

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## Axis RF Meter Quick Start Guide

This meter has many capabilities, including memory, alarm, date/time, average etc. which will require some study of the manual to use properly. However, you can quickly and easily begin making measurements right out of the box. Just follow these simple steps:

1. Insert 9V battery.
2. Turn meter on with GREEN button.
3. Press XYX/MEM button until all three (XYZ) letters are displayed on the screen (to the left of the main number.
4. Press UNIT/ENTER button until the desired units are displayed below the main number (we recommend using mV/m... and we recommend a maximum level of 614 mV/m for prolonged exposure).

You are now ready to make your first measurements!





## 1 Introduction

This meter is designed for measuring and monitoring Radio–Frequency electromagnetic field strength. The meter is calibrated precisely over the frequency range of 10Mz~8GHZ.

## 2 Simple a method of operation

Press “power” button on.To change measuring unit (mV/m), push UNIT”button to change the unit.Electric field strength (V/m).Computed magnetic field strength (mA/m).Computed power density ($mW/m^2$).Computed power density ($\mu W/cm^2$).

Press "xyz" this key to change sensor axis selector:

“All axis ” → “X axis” → “Y axis” → “Z axis”.

## 3 Fundamentals

**Electromagnetic pollution**

This meter is used to indicate electromagnetic pollution generated artificially. Wherever there is a voltage or a current, electric (E) and magnetic (H) fields arise. All types of radio broadcasting and TV transmitters produce electromagnetic fields, and they also arise in industry, business and the home, where they affect us even if our sense organs perceive nothing.

## 4 Electric field strength (E)

A field vector quantity that represents the force (F) on an infinitesimal unit positive test charge (q) at a point divided by that charge. Electric field strength is expressed in units of volts per meter (mV/m). This meter measures electric field strength directly.

### 4.1 Magnetic field strength (H)

A field vector that is equal to the magnetic flux density divided by the permeability of the medium Magnetic field strength is expressed in units of amperes per meter





calculate the magnetic field for the electric field value. This meter can display the calculated magnetic field strength.

### 4.2 Power density (S)

Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter ($W/m^2$) or, for convenience, units such as mill watts per square centimeter ($mW/cm^2$)

### 4.3 The characteristic of electromagnetic fields

Electromagnetic fields propagate as waves and travel at the speed of light (C). The wavelength is proportional to the frequency.

$\lambda$ (wavelength) = C (speed of light) / f (frequency)

If the distance to the field source is less than three wavelengths, then we are usually in the near field. If the distance is more than three wavelengths, the far-field conditions usually hold.

In near field conditions, the magnetic field value cannot be calculated from the electric field value. This meter is designed for reliable far field measurements only.

## 5 Application

- Quite often routine, maintenance and service work has to be done in areas where active electromagnetic fields are present, e.g. in broadcasting stations, etc. Additionally, other employees may be exposed to electromagnetic radiation. In such cases, it is essential that personnel be not exposed to dangerous levels of electromagnetic radiation, such as:
- High frequency (RF) electromagnetic wave field strength measurement.
- Mobile phone base station antenna radiation power density measurement.
- Wireless communication applications (CW, TDMA, GSM, DECT).
- RF power measurement for transmitters.
- Wireless LAN (Wi-Fi) detection, installation.
- Spy camera, wireless bug finder.
- Cellular /Cordless phone radiation safety level.
- Microwave oven leakage detection.
- Personal living environment EMF safety.





## 6 Features

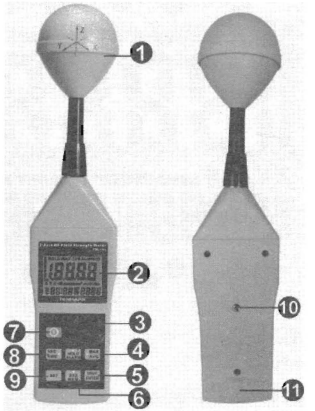
- The meter is a broadband device for monitoring high- frequency radiation in the range from10MHz to 8GHz
- The non-directional electric field antenna and high sensitivity also allow measurements of electric field strength in TEM cells and absorber rooms.
- The unit of measurement and the measurement types have been selected to expressed in units of electrical and magnetic field strength and power density.
- At high frequencies, the power density is of particular significance. It provides a measure of the power absorbed by a person exposed to the field. This power level must be kept as low as possible at high frequencies.
- The meter can be set to display the instantaneous value, the maximum value measured or the average value. Instantaneous and maximum value measurements are useful for orientation, e.g. when first entering an exposed area.

- For isotropic measurements of electromagnetic fields.
- Non-directional (isotropic) measurement with three-channel measurement sensor.
- High dynamic range due to three-channel digital results processing.
- Configurable alarm threshold and memory function.
- Easy & safe to use
- Low battery detector "[-+]".
- Manual data memory storing: 200 data sets.
- Memory Over load indication "OL".



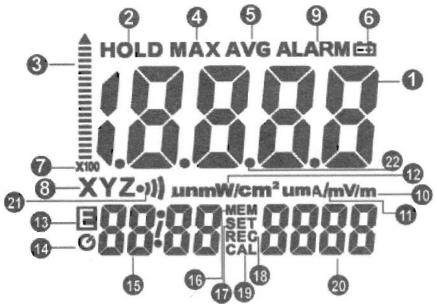


## 7 Identifying Parts




1. RF three-Axis Sensor.
2. Liquid-crystal LCD.
3. Hold /ALARM / Up Button.
4. MAX / AVG/ Right Button.
5. UNIT / ENTER Button.
6. XYZ / MEM / Down Button.
7. Power Button.
8. REC/ time / Leftward Button.
9. SET Button.
10. Tripod mounting screw.
11. Battery Cover.

## 8 LCD Description




1. Primary Display
2. Hold symbol
3. Analogue bar graph
4. MAX symbol
5. AVG symbol
6. Low battery symbol
7. x1x10x100 unit
8. X.Y.Z unit
9. ALARM sound
10. mV/m, V/m (E)
11. µA/m , A/m unit (H)
12. µW/m$^2$/ µW/cm$^2$unit
13. E Symbol
14. Auto power off symbol
15. Time unit (month: day) (hour: minute) (second)
16. MEM reading symbol
17. SET symbol
18. REC symbol
19. CAL symbol
20. Secondary Display
21. BUZZER symbol
22. Decimal point





## 9 Specifications

### 9.1 General specifications

- Display type: Liquid-crystal (LCD), 4-1/2 digits maximum reading 19999.
- Measurement method : Digital, Tri axis measurement.
- Directional characteristic: Isotropic, Tri axis.
- Measurement range selection: one continuous range.
- Display resolution : Display resolution:0.1mV/m, 0.01V/m, 0.1µA/m, 0.1mA/m,0.001µW/ m$^2$, 0.01mW/ m$^2$, 0.001µW/cm$^2$
- Setting time: typically 1.5s (0 to 90% measurement value.)
- Sample rate: 1.5 times per second.
- Sample rate: 3 times per second.
- Audible alarm: Buzzer.
- Units: mV/m, V/m, µA/m, mA/m, µW/ m$^2$, mW/m$^2$, µW/cm$^2$
- Display value: Instantaneous measured value, maximum value, average value, or maximum average value.
- Alarm function : adjustable threshold with ON / OFF

- Calibration factor CAL: adjustable
- Manual data memory and read storage: 200 data sets.
- Batteries : 9V NEDA 1604, IEC 6F22 or JIS 006P
- Battery life: Approximate 15 hours.
- Auto power off: Default time 15 minutes. Adjustable threshold 0~99 minutes.
- Operating temperature range: 0°C to + 50°C.
- Operating humidity range : 25% to 75 % RH
- Storage temperatures range: -10°C to +60°C.
- Storage humidity range: 0% to 80% RH.
- Dimensions: 370 (L)x80(W)x80(H) mm.
- Weight (including battery): Approx.400g.
- Accessories: User's manual, 9V battery, Carrying case.

**EMC**

This tester was designed in accordance with EMC Standards in force and its compatibility has been tested in accordance with EN61326-1 (2006).





**9.2 Electrical specifications**

- Unless otherwise stated, the following specifications hold under the following conditions:
- The meter is located in the far field of a source; the sensor head is pointed towards the source.
- Ambient temperature: +23 °C ±3°C.
- Relative air humidity 25%~75%
- Sensor type: electrical field (E).
- Frequency range: 10MHz ~ 8 GHz.
- Specified measurement range: CW signal (f >50MHz): 38mV/m to 11.00 V/m, 53.0uA/m to 28.64mA/m 0.1uA/$m^2$ to 309.3mW/$m^2$,0uW/$cm^2$ to 30.93mW/$cm^2$
- Dynamic range: Typically 75dB
- Absolute error at 1V/m and 2.45GHz: ± 1.0 dB.
- Frequency response: Sensor taking into Account the typical CAL factor:
  ±2.4dB(50 MHz to 1.9 GHz , 3.5 GHz to 8GHz).
  ±1.0dB(1.9 GHz to 3.5GHz).
- Isotropy deviation: Typically ± 1.0 dB (2.45GHz).

- Overload limit: 0.083 mW/cm$^2$,(17.7 V/m) per axis.
- Overload limit: (0 to50°C): ± 0.2dB.

### 9.3 Units of measurement

The meter measures the electrical component of the field; the default units are those of electrical field strength (mV/m or V/m). The meter converts the measurement values to the other units of measurement, i.e. the corresponding magnetic field strength units (μA/m or mA/m) and power density units (μW/m$^2$, mW/m$^2$ or μW/cm$^2$ ) using the standard far-field formulate for electromagnetic radiation.

The conversion is invalid for near-field measurements, as there is no generally valid relationship between electrical and magnetic field strength in this situation. Always use the default units of the sensor when making near-field measurements.

### 9.4 Result modes

The bar graph display always shows the instantaneous measured dynamic range value. The digital display shows the result





according to one of three modes, which can be selected.

Instantaneous: The display shows the last value measured value measured by the sensor, no symbol is displayed.

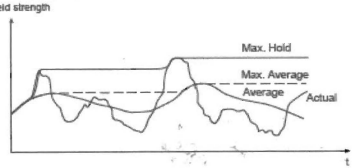
Maximum instantaneous (MAX):

The digital display shows the highest instantaneous value measured, the "MAX "symbol is displayed.

Average (AVG): The digital display shows the average value measured, the "AVG" symbol is displayed.

Instantaneous mode is the default setting when the meter is turned on. The following graph shows of Instantaneous (actual), MAX (hold), AVG and

- **MAX/AVG:**




### Measurement Procedures and Preparation

Battery loading: Remove the battery cover

on the back and put a 9V battery inside.
Battery replacement: When the symbol of "[-+]" appears on the LCD display, the battery should be replaced with a new one.
The battery symbol will be displayed on the LCD, this is a battery low indicator.

### 9.5 POWER key :

Press "[ ⏻ ]" key turn ON the meter.

Press "[ ⏻ ]" key again to turn power OFF.

### 9.6 Data hold key:

Press the "[HOLD ALARM]" key to go into hold mode, and "HOLD" appears on the screen to allow you to read the data.

Press "[HOLD ALARM]" this key once again to deactivate it.

### 9.7 Units key:

Change units with the "UNITS" key as follows Electric field strength (V/m)
Computed magnetic field strength (mA/m).
Computed power density ($mW/m^2$).
Computed power density ($\mu W/cm^2$).
Press "[UNIT ENTER]" key to change the units: mV/m, V/m, μA/m, mA/m, $\mu W/m^2$, $mW/m^2$, $\mu W/cm^2$.

### 9.8 MAX / AVG Record:

Press "[MAX AVG]" key to switch to the next display. The display switches from MAX to AVG to MAX/AVG and back to MAX.

Press and hold "[MAX AVG]"key for 3 seconds to disable this function.
The maximum storage is up to 99 minutes and 99 seconds
After this period of time, updating will be completed automatically and then the LCD

displays E.

### 9.9 Manual data memory storing

Press"REC TIME" key, the meter will save the current measured result, and REC with a number 001~200 will appear.
Manual data memory Storing: 200 data sets.Over load Indication: "**OL**".

### 9.10 XYZ/CALL:

Press "XYZ MEM" this key to change sensor axis selector :" All axis "→" X axis "→" Y axis "→ " Z axis ".

### 9.11 Alarm ON/OFF Setup

Press hold "⏻" and "HOLD ALARM" key to switch the alarm function on The "ALARM" symbols in the display indicates that the alarm function is on. Press hold "⏻" and"HOLD ALARM" key to turn off the alarm





function. When the Alarm is ON, the display shows .

#### 9.11.1 Viewing Data Records

Press hold "⏻" key and press "REC TIME" key to view the saved data records Use "HOLD ALARM" or "XYZ MEM" key to see the next or previous records Press "UNIT ENTER" key to close the setup, exit the mode.

### 9.12 Cancel the automatic power off/on :

The default setting is auto power-off, the time is set for 15 minutes.
Press hold"⏻" key and press"UNIT ENTER" key to disable the automatic power-off, the symbol of ⏲ will be disappeared on the LCD display.
Press hold "⏻" key and "UNIT ENTER" key again to enable the automatic power-on,

the symbol of ⏲ will be appeared on the LCD display.

### 9.13 Clock LCD Display

Press hold "[ ]"key and press"[REC TIME]" key for more than seconds to select the display method of the Year, Month, Date, hour and Second.

This meter's clock uses 24 hour time setting.

Default time mode setting is "2010/01/07 00: 02" ":00".

## 10 Setup Mode

Press hold "[ ]" key first and "[SET]" button to enter the Setup Mode.

Press "[SET]" key to change setup function. (Setup function see Note1)

Push "[UNIT ENTER]" key to save setup data

Note1: you can set up 6 different functions in setup mode Clock Setup

- setup 1 : Setting the alarm limit value (ALARM)
- setup 2 : Clear data logger memory





- setup 3 : Analogue bar graph X1.X10.X100
- setup 4 : Auto Power Off Time
- setup 5 : Setting the calibration factor (CAL)

### 10.1 Clock Setup-1

Press hold "[ ]" key first and "[SET]" key to enter the Setup Mode.

Press "[HOLD ALARM]"or "[XYZ MEM]" key to select option adjust.

Press "[REC TIME]"or "[MAX AVG]" key to change the date and time (hour→day→month→year →minute).

Press "[UNIT ENTER]" key to save and exit.

This meter clock is 24 hour time setting.

Date/Time default Format : 2009/12/21 12:12.

Year Format: 2000~2099 display as 00 ~ 99.

### 10.2 Setting the alarm limit value (ALARM)-2

The alarm limit value is used to monitor the display value automatically. It controls the alarm indication function. The alarm limit value can be edited in the displayed V/m unit. The ALARM setting range is from 0.001 to 999.9V/m. ALARM default is set at 999.9V/m.

Alarm limit function is only used for total three axial value Comparator.

Press hold "[ ]" key first and "[SET]" key to enter the Setup Mode.

Press "[SET]"key again to enter the alarm setting mode.

Press "[MAX AVG]" key to move decimal.

Press "[REC TIME]" key to select the desired setting value.

Press "[HOLD ALARM]"key and "[XYZ MEM]" key to change digit.

Press "[REC TIME]" key to select the value.

Press "[UNIT ENTER]" key to store the new setting value and exit.

### 10.3 DEL data logger memory setup-3

Press hold "[ ]" key first and "[SET]" key to enter the Setup Mode.

Press"[SET]"key twice to enter the default display "nO", Press "[XYZ MEM]"or "[HOLD ALARM]"key to select "YES".

Press "[UNIT ENTER]" key to delete the memory and exit.

Press"[XYZ MEM]"or "[HOLD ALARM]" key to

select "SET 088" and then press "UNIT ENTER" to keep the memory and exit.

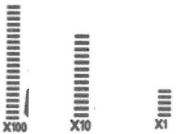
### 10.4 Analogue bar graphsetup-4

Press hold "⏻" key first and "SET" key to enter the Setup Mode.

Press "SET" key for three times to enter the analogue bar graph setting mode.

The "graph" unit is flashing displayed X1、X10、X100.

Press"HOLD ALARM"or "XYZ MEM" key to select the value X1 、X10 、X100。




Press "UNIT ENTER" key to save and exit.

### 10.5 Auto Power Off Time function setup-5

Press hold "⏻" key first and "SET" key to enter the Setup Mode.





Press "SET" key for four times, the symbol ⊙ is displayed.

The auto power off time default setting is 15 minutes.

Press "HOLD ALARM" and "XYZ MEM" key to change the: 00~:99 minutes.

Press "UNIT ENTER" key to save and exit.

:00 → Auto power off disable.

:99 → Maximum auto power off time

### 10.6 Setting the calibration factor (CAL)-6

Press hold "⏻" key first and "SET" key to enter the Setup Mode.

Press "SET" key for five times to display

the " CAL SET " the default factor .

The CAL setting range is from 0.10 to 9.99.

Press "HOLD ALARM"or" XYZ MEM key to select the value.
Press "REC TIME "or "MAX AVG"key to select the digits.
Press "UNIT ENTER" key to save and exit.

## 11 Calibration factor is important for the measurements:

The calibration factor CAL serves to calibrate the result display. The field strength value measured internally is multiplied by the value of CAL that has been entered and the resulting value is displayed. The CAL setting range is from 0.10 to 9.99.
The CAL factor is often used as a means of entering the sensitivity of the field sensor in terms of its frequency response in order to improve measurement accuracy.

The following effect will be noted with all field strength meters:

- If the sensor is moved quickly, excessive field strength values could be displayed. This effect is caused by





electrostatic charges.
- Recommendation: hold the meter steady during the measurement.

### 11.1 Short-term measurements:

**Application** : Use either the "instantaneous" or the "Max .instantaneous" mode, if the characteristics and orientation of the field are unknown when entering an area exposed to electromagnetic radiation.

### 11.2 Short-term measurements

**Procedure** : Hold the meter at arm's length.
Make several measurements at various locations around your work place or the interested areas as described above. This is particularly important is the field conditions are unknown.
Pay special attention to measuring the vicinity of possible radiation sources. Apart from active sources, those components connected to a source may also act as radiators. For example, the cables used in diathermy equipment may also radiate electromagnetic energy. Note

that metallic objects within the field may locally concentrate or amplify the field from a distant source.

**11.3 Long-term exposure measurements**

**Location** : Place the meter between yourself and the suspected source of radiation. Make measurements at those points where parts of your body are nearest to the source of radiation.

**Note** : Use the "Average" or" Max average" modes only when the instantaneous measurement values are fluctuating greatly. You may fix the meter to a wooden or plastic tripod.

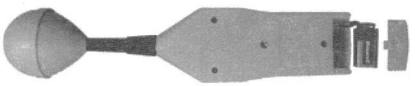
## 12 Battery replacement

| | waring |
|---|---|
| ⚠ | If the symbol " [−+] " appears on the LCD, please replace the battery immediately |

- Turn off the instrument.
- Remove the battery cover
- Replace the battery.
- Install the battery cover.

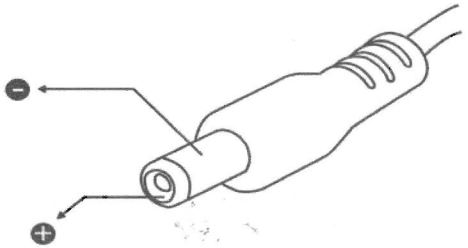






## 13 External DC Power

- External AC to DC adapter: Voltage 9VDC(8~14VDCMax)
- Supply current : >300mADC
- Socket : pin Positive, Ground Casing External
- Diameter 6.3mm; internal Diameter 2.0 mm



## 14 Safety Precaution

- For cleaning the instrument use a soft dry cloth. Never use a wet cloth, solvents or water, etc.
- Operation Altitude：Up to 2000M.
- Operating Environment： Indoors use.

This instrument has been designed for being used in an environment of pollution degree 2.





## 15 SAFETY INFORMATION

**CAUTION**

Before making a measurement, check if the low battery symbol" " is shown on the display as soon as the meter is switched on. Change the battery if the symbol is displayed.

In the case of prolonged storage, it is preferable to remove the battery from the meter.

Avoid shaking the meter, particularly in the measurement mode.

The specified limits outside and improper handling may adversely affect the accuracy and function of the meter.

## 16 SAFETY INFORMATION

**DANGER**

In some cases, work in the vicinity of powerful radiation sources can be a risk of your life.
Be aware that persons with electronic implants (e.g. cardiac pacemakers) are subject to particular dangers in some cases.
Observe the local safety regulations of the facility operation.
Observe the operating instructions for equipment, which is used to generate, conduct, or consumer electromagnetic energy.
Be aware that secondary radiators (e.g. reflective objects such as a metallic fence) can cause a local amplification of the field.
Be aware that the field strength in the near vicinity of radiators increases proportionally to the inverse cube of the distance. This means that enormous field strengths can result in the immediate vicinity of small radiation sources (e.g. leak in wave guides, inductive ovens)
Field strength measuring device can underrate pulsed signals.
Particularly with radar signals, significant measurement errors can arise.
All field strength measuring devices have a limited specified frequency range. Fields with spectral components outside of this frequency range are generally





incorrectly evaluated and tend to be underrated. Before using field strength measuring devices, you should thus be certain that all field components to be measured lie in the specified frequency range of the measuring device.

## 17 End of life

**Caution** : this symbol indicates that equipment and its accessories shall be subject to a separate collection and correct disposal

TENMARS

**Professional Electrical and Environment Test & Measurement Instruments:**

LED light meter, Temperature & Humidity meter, Infrared Thermometer, Sound level meter Light meter, EMF meter, UV Light meter, RF meter, Hot wire Anemometer, Co meter Anemometer, Lan cable tester, Co2 meter, Solar power meter, Radiation meter, Clamp meter, Multimeter, Phase Rotation test, Digital Insulation tester

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